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DIPTERYGIUM—CRUCIFERAE OR CAPPARACEAE?

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ABSTRACT. *Dipterygium* Decne., a monotypic genus centred in Arabia, has variously been considered as belonging to Cruciferae or Capparaceae. Although on floral and fruit morphology it is only marginally better placed in the Capparaceae, the chemical evidence is strongly in favour of its affinity with this family. Methylglucosinolate, common in Capparaceae but unknown in Cruciferae, is shown unequivocally to be present in *D. glaucum*.

Dipterygium Decne. is a distinct monotypic genus described originally in Cruciferae, but now usually placed in Capparaceae. *D. glaucum* Decne. is a rather insignificant shrub or subshrub with few simple leaves and inconspicuous flowers. It is distributed throughout the mainly tropical and subtropical desertic areas of Egypt, Sudan, Somalia and Arabia, reaching its eastern limit in Pakistan (fig. 1). In some parts of its range, such as Arabia, it is a very frequent plant. In its floral characters of 4 free sepals, 4 cruciform petals, 6 stamens and a 2-ovulate gynoecium, *Dipterygium* has the characteristic features of Cruciferae and in general facies it looks like a member of that family and not of Capparaceae. Fuller descriptions of the plant can be found in Floras of its area [such as Rech. f., *Flora Iranica* (no. 68, 1970) and Nasir & Ali, *Flora of W Pakistan* (no. 34, 1973)].

Before going on to consider the new chemical evidence it is worthwhile giving a short précis of the taxonomic history of the genus and discussing its morphological characters vis-à-vis Cruciferae and Capparaceae.

Decaisne in his original description of *Dipterygium* (*Ann. Sci. Nat.* sér. 2, 4:66, 1835) assumed that he was dealing with a Crucifer, because of its floral and fruit structure, and discussed its apparent relationships with *Isatis* L. and *Tetrapterygium* Fisch. & Mey. (now an infra-generic group of *Sameraria* Desv.). He concluded that it was very isolated in the family without any obvious allies. Steudel (*Nomenclat. Bot.* ed. 2, 2:413, 1841), using the invalid name *Pteroloma arabicum* Hochst. & Steud. referred it to the same family and was followed by Hooker & Thomson (*Journ. Linn. Soc.* 5:179, 1861) who placed it near to *Tauscheria* Fisch. and *Neslia* Desv. In *Genera Plantarum* (1:95, 1862) Bentham & Hooker also favoured its allocation to Cruciferae and listed it within tribe Isatideae on account of its indehiscent 1-seeded winged fruits; they placed it in a subgroup, with incumbent radicles, beside *Isatis* and *Tauscheria*.

Boissier (*Fl. Orient.* 1:417, 1867) seems to have been the first botanist to transfer it to the Capparaceae (Capparidaceae) acknowledging that it was his colleague Bunge who had expressed doubts about it being a Crucifer. Boissier found no obvious ally for it in its new family and described the monotypic subtribe Dipterygiae of the Cleomeae to accommodate it. Since then, with few exceptions, *Dipterygium* has been placed in Capparaceae by most authors. In the 12th edition of Engler & Prantl's *Syllabus der*

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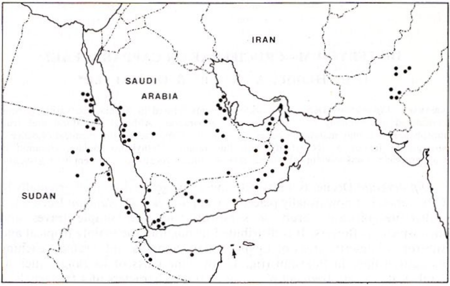


FIG. 1. Distribution of *Dipterygium glaucum* Decne.

Pflanzenfamilien (1964), it is in the subfamily Dipterygioideae (one of the eight subfamilies recognized) together with the little known monotypic *Puccionia* Chiov. (*P. macradenia* Chiov.) from Somalia and Ethiopia. None of these authors, however, gives very convincing reasons for believing it better placed in this family.

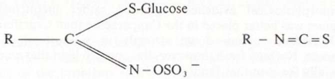
What then are the pros and cons of *Dipterygium* belonging to one family or the other? It does, as mentioned above, have 4 sepals and petals, 6 stamens, a 2-ovulate ovary (borne on a short gynophore) and 1(–2)-seeded indehiscent winged fruits; these characters together are generally diagnostic for the Cruciferae, and at least uncommon in the Capparaceae. However, there is one feature in *Dipterygium* which is anomalous in the Cruciferae: the stamens are all equal in length, not tetradynamous (4 long, 2 short). Although in Capparaceae most species have numerous stamens and often the ovary is borne on a prominent gynophore, there are several members especially in the *Cleome* part of the family with 6 stamens, equal in length, and lacking or with only a short gynophore. When it comes to fruit characters the two families can almost always be separated by the presence of a false septum in Cruciferae. Unfortunately this normally diagnostic difference is of no use in our case because there are some 1- or 2-ovulate, 1-seeded Crucifers in which there is no full development of a false septum; and our plant is 2-ovulate, 1(–2)-seeded and eseptate! A further frequently useful character for separating the two families—though in the vast majority of cases one is very unlikely to confuse them—is that of the indumentum. But again we are stymied because *Dipterygium* is usually glabrous!

On the evidence therefore of gross floral and fruit morphology, it is only the equal-lengthed stamens which favour our plant as a member of Capparaceae. In this respect though, it should be mentioned that in many of

the small-flowered Crucifers, the 4+2 staminal arrangement is at best indistinct.

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Turning now to the chemical evidence, both Cruciferae and Capparaceae contain glucosinolates, chemical constituents of some importance in separating the two families. The glucosinolates, as known today, encompass about 75 individual anions (1), limited in their natural occurrence to dicotyledonous angiosperms and varying solely in the chemical character of the substituent R (cf. Kjær & Olesen Larsen, *Biosynthesis,* The Chemical Society, 2:95, 1973; 4:200, 1976; 5:132, 1977; and references therein).



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Invariably, the glucosinolates are accompanied in nature by specific enzymes, myrosinases, catalysing their hydrolysis to glucose, sulphate, and isothiocyanates (mustard oils) (2), the latter recognizable by their pungent taste.

The natural distribution of glucosinolates is discontinuous, with a conspicuous accumulation within the order Capparales. In fact, we know of no taxon belonging to the families Capparaceae, Cruciferae, Moringaceae, Resedaceae and Tovariaceae devoid of glucosinolates (Kjær, *Chemistry in Botanical Classification,* Nobel Symposium 25:229, 1974, Academic Press). Outside this natural alliance, however, glucosinolate occurrences are few and rather sporadic.

The glucosinolate pattern of a certain taxon appears to be virtually invariable. Hence, the extant list of patterns of several hundred species from all families within Capparales provides a reasonably reliable chemosystematic guide. In the present context the natural distribution of methylglucosinolate (1, $R = CH_3$) deserves particular attention. While widely distributed throughout the Capparaceae (Kjær, *op. cit.*), this particular glucosinolate seems curiously absent from the almost 400 Crucifer species studied (Gmelin & Kjær, *Phytochemistry* 9:569, 1970). On this background we undertook a study of the glucosinolate pattern in two seed collections of *Dipterygium glaucum,* one from Saudi Arabia (7 km W Dharan, 31 v 1974, *Mandaville*), the other from southern Egypt (Elba mts, near Red Sea and Sudan frontier, 3 vii 1979, *El-Menshawi*).

Dry fruits (seeds and pods) (1 g) were disintegrated and extracted with hot 70% methanol. The extracted material, dissolved in water, was applied to an ion-exchange column (Ecteola cellulose in the acetate form), and the glucosinolate fraction was eluted with pyridine. The residue was subjected to silylation, followed by gas chromatography (3% OV-1; 200°→280°, 2°/min.). Only one significant peak was observed (retention time: 6.6 min.), indistinguishable from that given by an authentic specimen of

methylglucosinolate similarly treated. By internal standard the content of methylglucosinolate in the fruit material was estimated to be about 2%. Additional structure confirmation was provided by subjecting the glucosinolate fraction to enzymic hydrolysis with myrosinase, extracting the reaction mixture with chloroform and ether, and applying the concentrated extract to a gas chromatograph connected with a mass-spectrometer. Both retention time and mass spectrum were identical with those found for an authentic specimen of methyl isothiocyanate (2, $R = CH_3$). The two seed samples, of widely different provenance, exhibited identical glucosinolate patterns.

Conclusion

The morphological evidence suggested rather inconclusively that *Dipterygium* was better placed in the Capparaceae than Cruciferae, but the chemical evidence comes down strongly in support of it being in Capparaceae. Nothing fresh, however, has come to light that would suggest a generic ally for it in that family.

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